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tion by functions with a given number of parameters.'

J. I. HUTCHINSON: 'On loci the coordinates of whose points are abelian functions of three parameters.'

L. P. EISENHART: 'Applicable surfaces with asymptotic lines of one surface corresponding to a conjugate system of another.'

H. B. LEONARD: 'On the factoring of composite hypercomplex number systems.'

FRANK MORLEY: 'Reflexive geometry.'

G. A. MILLER: 'Generalization of the groups of genus zero.'

E. B. WILSON: 'On divergence and curl.'

E. B. WILSON: 'Oblique reflections and unimodular strains.'

E. B. WILSON: 'Double products and strains in  $n$  dimensions.'

F. R. MOULTON: 'A class of three dimensional periodic orbits in the problem of three bodies, with applications to the lunar theory.'

OSKAR BOLZA: 'Weierstrass's theorem and Kneser's theorem on transversals for the most general case of an extremum of a simple definite integral.'

The next meeting of the society will be held at Columbia University on Saturday, October 27. The San Francisco Section met at the University of California on Saturday, September 29.

F. N. COLE,  
*Secretary.*

#### THE EDINBURGH MUSEUM.

THE Edinburgh museum challenges attention. It is significantly *useful*, and seems to attempt to make its collections supplementary to class-room study; nor is there any hesitancy shown in displaying specimens to the limits of its capacity, as long as they contribute in the slightest degree to the need of the student. Its methods of installation are not expensive or elaborate, but they show painstaking care, considerable ingenuity and promise to be made progressively better and more complete.

There can be no question as to the richness of its possessions in geology and lithol-

ogy and Scottish mineralogy, nor is there reason to look askance upon their splendid biological demonstrations. The writer enjoyed the opportunity of only one or two visits to its crowded halls, and then confined his attention to the departments of natural history, which are in it associated with very satisfactory, in some instances most valuable, collections, illustrating machinery, fictile art, ceramics, design, ethnology, sculpture, architecture, industries, chemistry, navigation, archeology and house furnishings.

There are evidences in many places of unfinished plans, of reorganization and experiment, but the museum indubitably claims the attention, and admiration, in some ways, of every museum promoter and officer, and its own relations to the inquisitive Scotch public are wholesome and helpful.

Criticism in some particulars might naturally be provoked as where in one hall or room, mammals, birds, insects, crustaceans, fish, shells, echinoids and hydrozoans are grouped together, and in another invertebrate fossils and birds, while in a third there are discovered birds, invertebrate fossils and corals. This peculiar juxtaposition is doubtless referable to want of space, capacious as the museum is, and not in all instances to the aims of comparative study.

The museum is on Chamber Street between South and George Bridge Streets, beyond St. Giles cathedral, not far from the university, and opposite the Watt College. It consists of a long (250 feet) three-storied skylighted oblong section with terminal buildings disposed at right angles to the axis of the main structure, and similarly arranged in three stories with skylights, except that their anterior portions are also illuminated by the introduction of wall windows. Back of the main series of halls or galleries, as they might be called, are three large rectangular

halls with basement floor, and galleries, also deriving their illumination from above. The lighting generally is most serviceable, for, by reason of the immense skylight space, of absolutely clear glass, the narrowness of the galleries, and the height of the ceilings, no hopelessly heavy shadows are cast; and, at least when the writer was there, on a brilliant day, the light was superabundant. As a matter of fact, white shades covered the skylights and helped advantageously to diffuse and diminish the light. Reflections in the flat cases around the balustrades of the central opening, on the galleries, were noticeable, and of course annoying, but could be quickly dissipated by holding a hat above them.

One of the striking features in the natural history exhibit is the elaborate art expended upon dissected animals, the explanation of their parts and the beauty and thoroughness of many of the preparations. Zoantharia, sea urchins, star-fish, insects, crustaceans, worms, fish, are thus accurately dissected, their organs named, helpful addenda of elucidations and suggestions appended, all clearly printed, and assisted by drawings, frequently colored. These preparations, as with many of the insects and crustacea, and spiders are mounted dry, and others are in alcohol in flat jars, the object being quite usually on blue glass with red threads connecting each part with its printed *name*, which latter appears on the plate or board, which holds the specimen. The dissections of the thornback ray, the torpedo, the dog-fish, the skate, with developing young are superb. The amphibia are similarly treated, and near them is noticed a splendid exhibit of the osteology of the cod. Further on in this section are some absolutely unimpeachable examples of the phases of bird feathering, and the tract-distribution of feathers illustrating pterylography. Amongst these is

a very succinct and forcible demonstration of the terminology of the feathers of the ring dove.

Throughout this section the exceeding cleverness and technical power of Mr. W. Eagle Clarke, and Mr. P. H. Grimshaw are in evidence. Many, and most of the difficult subjects, are their personal handiwork, always, I believe, submitted to the approval of Dr. Traquair, the director of the museum, who is now about to retire.

The mollusca are also ecologically discussed in diagrams, selected specimens and dissections. There are important groups of specimens illustrating types of shells, their external and internal features, old and young conditions, terminology of parts, the muscular impressions, in the shells clearly delineated by red painting, also hinges and teeth, the nature of the margins of the valves, pedal, siphonal and byssal openings, position of umbones, terminology of the multivalvular forms; forms of shell, as dextral, sinistral, elongate, subulate, tubular, cylindrical, ovate, globose, turbate, involute, conical, cordate, etc.; the ornamentation, as granulate, pustulate, subnodose, reticulate cancellate, spinose, clathrate, costate; colors; variations of sculpture as so well shown in *Pecten glaber*, *Liguus virginia*, *Helix nemoralis*; protection as in *Xenophora conchyliophorus* (with its attached shells); and the varying aspects of the periostracum.

The examples under the above heads are mounted on gray cards with black centers, explained by clear clean printed labels. In the molluscan biology excellent preparations most graphically instruct the visitor in the anatomy of the common shells, and some, as those of the cephalopods, merit pronounced praise. The morphological and embryological study is continued in this hall throughout the animal kingdom.

The specimens of fossils from Cambrian

to Pleistocene are superior, though they seem to lack effectiveness from their irregular distribution in various halls; thus in the hall of fossil fish there is a fine collection of living fishes, sponges and *graptolites*. Many of the invertebrate fossils are grouped with the living shells, not of course at all confusedly, but in the same hall in wall cases. Noticeable in one group is an interesting collection of fossil foot-prints from the new Red Sandstone of Corncockle Muir, Dumfriesshire, formed by the late Sir Wm. Gardine, Bart, and containing the specimens described and figured by him in his 'Ichnology of Annandale.'

The Devonian fossil fish easily take precedence amongst the fossil collections, and they possess an unmistakable distinction. They make up a wonderful collection. Here are the Devonian genera, *Asterolepis*, *Bothriolepis*, *Cephalaspis*, *Coccosteus*, *Cyroptychius*, *Diplopterus*, *Dipterus*, *Drepanaspis*, *Eusthenopteron*, *Holoptychius*—a superb slab, three feet long, shows a group of one species of this genus—*Glyptolepis*, *Homosteus*, *Osteolepis*, *Phanero-pluron*, *Pteraspis*, *Pterichthys*, *Thrusius*, *Tristichopterus*. The carboniferous Jurassic and Tertiary fishes are also of unusual value.

Amongst the fossil invertebrates attention may be justly called to the collection of specimens in the Carboniferous (especially instructive cephalopoda) and Jurassic sections, the interesting *hippuritidæ*, of the chalk, and one splendid example of *Requienia* (*R. ammonia*, Goldfuss) from the Meocomian of France. The Jurassic and Triassic Cephalopoda are superior in individual excellence, though the collection does not seem very large. The polished Triassic Ammonoidea are certainly handsome. The Paleozoic fossils are naturally of great interest, but incomparably poorer in quality and numbers than the exhibition

of similar material from the same horizons in New York.

The fossils are mounted on buff boards with printed divisions, printed and written labels, and are somewhat incongruously associated with a collection of comparative craniology in the glass-fronted cases beneath them. In this same room is a collection of shells, evidently intended for comparative or morphological study, as it is far from being very extensive in numbers or in species. Models of *Arion* and *Limax* were noticed and apparently a cleverly mounted skin of *L. agrestis*, L. The fossil and living crustacea in this hall, in wall cases, were excellent, and the *Eurypterida* decidedly valuable.

A very excellent instance of an industrial exhibit may be profitably quoted as suggestive at least to curators contemplating similar objects. It is the care devoted to an instruction in the making of Wedgewood ware. Here under raw materials are placed boulder flint, gravesend flint, calcined flint, limestone, chertstone, compact gypsum, flint dried and ground to a firm mass as used in the glazes, raw Swedish feldspar, Swedish feldspar fired in the biscuit oven, gray marl, seggar clay, a mixture of gray, black and red marls passed through a couple of rollers, blue ball or poole clay. Blue clay fired in the biscuit oven, black clay, another kind of ball clay, china clay, Cornish clay or kaolin (a fine white clay obtained from the decomposed feldspar which is washed out of certain Cornish granites), china clay with sand washed out, china clay fired in the biscuit oven, native china clay before being washed, hard Cornish stone fired in the highest heat of the biscuit oven, china clay fired in the highest heat of the biscuit oven, blue clay fired in the highest heat of the biscuit oven, black clay, gray marl, red marl, all fired in the biscuit oven, calcined flint broken or stamped, flint knockings—

the pieces discolored by oxide of iron picked out as waste, American feldspar calcined in the glass oven, calcined feldspar ground and ready for use in Parian, soft Cornish stone (slightly decomposed, most decomposed, etc.), hard and soft Cornish stone fired in the biscuit oven, hard and soft Cornish stone ground and mixed, as used for the body and glaze of ware, pigments, glazes, slips, frits, chemicals (about ninety glass bottles enclose these ingredients), and the various stages of the ware with implements, in a superb and very precious exhibit of vessels, vases and plaques, partly chronological.

The archeological and ethnological exhibits are of great merit and value. A small group of objects labeled 'chemical balance and other apparatus used by Professor Joseph Black' will attract the reverent attention of chemists.

The general mineralogical collection is an excellent and adequate representation of the mineral retinue of species from the native elements to the hydrocarbons, though it is quite lacking in distinction or phenomenal beauty. It is well arranged, for purposes of study, in flat cases around the central opening under the skylight, and in flat cases about the walls, with larger specimens above and below the latter. There is noticeable in it good spodumene from Norwich, Conn., and hiddenite from North Carolina, a remarkable pink topaz from the Ural Mountains, three crystals of euclase, some striking scolecite from Iceland, excellent torbernite, superior barite crystals, a handsome halite group, an attractive exhibit of hydrocarbons, and a small complementary collection of pseudomorphs—of much interest—amongst which the pseudomorph of vesuvianite after garnet deserves mention. A beautiful crystalized gold specimen from Ballarat, weighing six and three fourth ounces, a large platinum nugget, good atacamite, crystals,

corundum, bournonite, green fluors, apophyllite from India, and the handsome ruled agates from the Faroe Islands are also memorable.

In lithology the constituents of rocks are shown, their combination in rock structure and examples of characteristic rocks, as acid, subacid, basic, metabasic, etc.; while structure and phase receive illustration under metamorphism, shearing, crumpling, foliation, lamination, ripple-marks, etc. Many crystallographic drawings appear throughout, and labels are sometimes very elaborate, as take, for instance, this one under pseudomorphism:

*Mould-Formation, with Removal of Pattern Quartz Coating Galena.*—There has, in this specimen, been two successive depositions of Galena, with investiture of quartz. After the removal of the first formed crystals of galena, a second and larger set of crystals of galena has been laid down upon the first formed layer of quartz. These in turn have been invested by a layer of quartz, and thereafter have been themselves removed; Leadhills, Scotland.

The climax of excellence in the museum, in the opinion of the writer, is reached in the hall devoted to Scottish geology. The exhibit here of rocks and minerals is remarkably effective, and in its lithological aspects quite extraordinary. Here are gathered together the minerals of Scotland, views of its geological scenery, with a display of rock specimens, luminously referred to position by maps, marked with pins and numbers, correlated exactly with the specimens of rocks near them. There are also relief maps dissected, colored and explained, and on the walls the fossils of Scotland with a long series of prehistoric flints, while upright A-shaped cases engage immediate notice from interesting and handsome specimens of geological structure, mineral masses and lithological phases contained in them. This hall contains a wealth of Scottish mineral treasures, and will reward the student by a

comprehensive showing of Scotland's geological history and mutations.

Among its extraordinary features he will be attracted to the Heddle collection of cut and polished agates with their labeled parts and exposition. It is well known that Dr. Heddle took a very particular interest in the genesis of agates and related mineral phenomena, and the little leaflet which may be purchased at the door of the museum to-day may be regarded as a complete expression of his opinions—convictions in this matter he conscientiously repudiated—on the subject. It has been prepared by Mr. J. G. Goodchild. The extensive display of cut agates will surprise visitors and seems, perhaps, rather needlessly elaborated. But these small nodules, cut across their longest diameter and polished, are very attractive, and the short attached printed labels reveal differences in structure and composition which are very interesting. It is impossible to even epitomize Dr. Heddle's views on this subject in this article, but it may interest readers to learn that the late Dr. Heddle, of St. Andrews, formed a very large collection of agates, gathered from all parts of Scotland, principally with the view of obtaining definite information as to the developmental history of these forms of silica. This collection, on the death of Dr. Heddle, passed into the hands of Mr. Alex. Thoms, of St. Andrews, who, already a generous donor to the Scottish mineral collection, in 1898 presented to the museum 1,000 of Dr. Heddle's agates, all of them selected and typical examples. It is these specimens which are now carefully exhibited in their surprising variety in the hall of the Edinburgh Museum, enclosing its examples of Scottish geology.

The Edinburgh Museum is a plain and, probably, inadequately equipped museum; it is neither ostentatious nor unimportant,

it contains a great accumulation of material, and this brief notice may draw attention to it, amongst the numerous visitors to the Athens of the north. Such sketches of museums, imperfect and fragmentary as they may be, cumulatively help to increase the interest taken in museums by the lay and professional member.

L. P. GRATACAP.

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ISRAEL COOK RUSSELL.

THE senate of the University of Michigan has adopted the following memorial as offered by the committee, Professors Lombard and D'Ooge:

Again and for the third time within the short space of two months, the hand of death has been laid heavily upon us, and we are called to mourn the loss of another honored and beloved colleague.

Professor Israel Cook Russell entered upon his duties as professor of geology in this university in the autumn of 1892, and was stricken down in the midst of his work by an illness which after a few days terminated his life, on May 1, 1906. He was born near Garratsville, N. Y., December 10, 1852, son of Barnabas and Louisa Sherman (Cook) Russell. His ancestors were early settlers in New England. He was fitted for college at the Rural High School, Clinton, N. Y., and Hasbrook Institute, Jersey City. He entered the University of the City of New York in 1869, and was graduated bachelor of science and civil engineer in 1872. After pursuing graduate studies at the Columbia School of Mines, he was given the degree, master of science, by the University of New York in 1875. In 1874 he went to New Zealand as a member of the United States Transit of Venus Expedition, and in this connection made a journey round the world. On his return home in 1875 he was appointed assistant professor of geology in the Co-